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## Numerical Modelling of a District Scale Groundwater Heat Pump Operation: Case Study from Colchester, UK

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Groundwater heat pumps (GWHP) are an environmentally friendly and highly efficient low carbon heating technology that can benefit from low-temperature groundwater sources lying in the shallow depths to provide heating and cooling to buildings. However, the utilisation of groundwater for heating and cooling, especially in large scale (district level), can create a thermal plume around injection wells. If a plume reaches the production well this may result in a decrease in the system performance or even failure in the long-term operation. This research aims to investigate the impact of GWHP usage in district-level heating by using a numerical approach and considering a GWHP system being constructed in Colchester, UK as a case study, which will be the largest GWHP system in the UK. Transient 3D simulations have been performed pre-construction to investigate the long-term effect of injecting water at 5°C, into a chalk bedrock aquifer. Modelling suggests a thermal plume develops but does not reach the production wells after 10 years of operation. The model result can be attributed to the low hydraulic gradient, assumed lack of interconnecting fractures, and large (>500m) spacing between the production and injection wells. Model validation may be possible after a period operational monitoring.